Varying-smoother models, with applications to human brain development

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Motivated by studies of human brain development, we consider estimation of a mean function f(t,s) with “temporal” and “spatial” arguments, when the data are spatially smooth functional responses (in the sense of Ramsay and Silverman) but scientific interest centers on change with respect to time. Analogously to varying-coefficient models, which are linear with respect to time, the "varying-smoother" models that we consider exhibit nonlinear dependence on time that varies smoothly over space. We propose several spline-based approaches to estimating varying-smoother models, and elucidate their behavior by means of a new notion of pointwise degrees of freedom, which generalizes the classical idea of the degrees of freedom of a smoother. Finally, we present a curve clustering approach that offers a new way to map brain development, and that has been successfully applied to identify neurodevelopmental abnormalities associated with childhood-onset schizophrenia.

This is joint work with Lei Huang, Huaihou Chen, Rong Jiao and Stan Colcombe